

REMARKS

A. Request for Reconsideration

Applicants have carefully considered the matters raised by the Examiner in the outstanding Office Action but remains of the position that patentable subject matter is present. Applicants respectfully request reconsideration of the Examiner's position based on the Claim Amendments and the following remarks.

B. The Invention

The invention relates to a crucible used for directional solidification and pulling of silicon single crystals.

In order to emphasis that the invention is to a crucible claims 1 and 2 have been amended herein to specify that they are to a crucible. It should be noted here that these claims are article claims and that none of the applied references teach a crucible.

Crucibles are vessels which are used to hold materials that are heated to very high temperatures. In the field of silicon processing, crucibles are usually trough shaped vessels in which molten silicon is solidified to form ingots or bars of solid silicon.

One of the unique aspects of the crucible of the invention is that the crucible consists of silicon nitride (Si_3N_4) particles. In order to emphasis this

aspect of the present invention, claim 1 has been amended to recite that the crucible consists of Si_3N_4 particles.

It should also be noted here that none of the cited reference teach a crucible consisting of silicon nitride.

C. Claim Status and Amendments

Claims 1-12 are pending in this application. Claims 1, 2 and 6-12 are under examination, while claims 3-5 have been withdrawn as directing to non-elected inventions.

Claims 6-9 have been added to claim the methods of using the crucible of claim 1 for directional solidification and pulling of silicon single crystals. Support to these claims can be seen from the Example 1 and 2, and page 3, lines 11-13.

Claim 10-12 have been added to further define the crucible. Support for these claims can be found on page 2 line 22 to page 2 line 13.

Claim 1 has been amended to particularly point out that it is a crucible consisting of Si_3N_4 particles made by nitriding compacted silicon powder. Support for this amendment can be seen from Example 1.

Further, Claims 1 -2 have been amended to conform to the conventional US practice.

There is no new matter added in the amendments.

D. The Election/Restrictions

Applicants confirm their election to group I, claims 1 and 2, without traverse.

E. Claim Rejections under 35 USC 103

The Examiner takes the position that claims 1-2 are unpatentable over Takeuchi in view of Kriegesmann. Applicants respectfully disagree.

1. All the claims recite a crucible and none of the cited references teach a crucible.

As noted above, claims 1, 2 and 10-12 are to a crucible while claim 6-10 are to a method of using the crucible. A crucible is specific article of manufacture. Typically, such article are trough shaped and have a cross section as illustrated in Figure 1. Crucibles and specifically crucibles intended for use in solidifying molten silicon have to be structurally strong enough to hold the enormous weight of the fluid silicon while the silicon slowly cools to a solid.

Takeuchi teaches ceramic porous bodies and, more specifically, filters and catalytic carriers, see column 1, lines 5-10. In each of the examples, the ceramic porous bodies are formed having a size of 100mm X 100mm square and a thickness of 15 mm; or a "disc" having a diameter of 25 mm and thickness of 0.5 mm. Presumably, these are illustrative of filters. Nowhere in Takeuchi does he teach a crucible or anything like a crucible.

In fact, Takeuchi teaches away from crucibles, especially a crucible with a high porosity like the one in the claims. Claims 1 and 6 specifically recite that the

porosity is 40-60% by volume. Takeuchi teaches that increases in pore size for ceramics generally means a decrease in strength. See column 1 lines 51-54. It is true that this cited passage is in the "Background" and that Takeuchi teaches that his material has both high strength and high porosity, but his high strength is for filters and catalytic carriers, not crucibles, which hold several tons of a molten metal.

It is submitted that Takeuchi teaches away from the use of his materials for crucibles.

Turning to Kriegesmann, he teaches that his material can be used to make kiln furniture, burner nozzles, rollers for roller ovens, and filters, see paragraphs 4 and 40. Nowhere does he teach that his material can be used for a crucible.

Claims 1, 2 and 6-12 are related to a crucible. None of the cited references teach or suggest a crucible, thus the claims are patentable over the references either alone or in combination.

2. All the claims recite the crucible consists of silicon nitride and the combined cited references do not teach a crucible consisting of silicon nitride.

As noted above, claims 1 and 6 recite that the crucible consists of silicon nitride. Furthermore, the material of the crucible has been defined as consisting of silicon nitride made by nitriding compacted particulate silicon.

Takeuchi teaches a porous body comprising silicon nitride and a compound of a rare earth element with at least 1 vol. % of an oxide of the rare earth element. The silicon nitride body is made by preparing a mix of **silicon nitride** powder and at least 1 vol. % of the rare earth oxide. Thereafter, a compact made from the mixed powder is heat treated at a temperature of at least 1500°C. (see line 49, column 3 to line 42, column 4 of Takeuchi)

In contrast the crucible of the present invention consists of silicon nitride. This wording excludes other components, such as rare earth. Additionally the claim recites that the silicon nitride is made by nitriding compacted particulate silicon. This nitriding process is substantially different from the sintering process in Takeuchi. The silicon nitride of the present invention is therefore different from the silicon nitride disclosed by Takeuchi, since he adds at least 1% rare earth and because he starts with a silicon nitride.

One of skill in the art would not replace composition of Takeuchi with the silicon nitride of Kriegesmann because Takeuchi teaches a porous body while Kriegesmann is silent about porosity and Takeuchi specifically teaches that increases in porosity yield decreases in strength.

Takeuchi states that: "In general, the strength of ceramics tends to be reduced following an increase in the porosity, and it has been extremely difficult to obtain compatibility between the porosity and the strength" (column 1 lines 51-54). Takeuchi teaches that rare earth is needed to obtain both porosity and strength. This concern regarding the strength of the porous body destroys the motivation to replace Takeuchi's material with the material of Kriegesmann. A

person skilled in the art would not be suggested by Takeuchi to use a porous body of silicon nitride **without the addition of a rare earth oxide** for a crucible.

3. Neither Takeuchi nor Kriegesmann teaches a silicon nitride coating on their articles.

Claim 2 recites a coating with silicon nitride having particle size of less than $50\mu\text{m}$. There is no teaching or suggestion of such a silicon nitride coating in either Takeuchi or Kriegesmann.

Applicants respectfully submit that neither Takeuchi nor Kriegesmann, nor their combination teaches or suggests a silicon nitride coating on the surface of the articles of manufacture.

Respectfully, the claims are patentable over Takeuchi and Kriegesmann, taken alone or in combination.

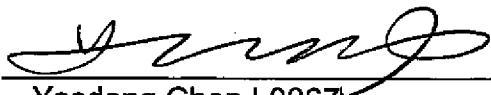
F. Conclusion

In view of the foregoing and the enclosed, it is respectfully submitted that this Application is in condition for allowance, and such action is respectfully requested.

Should any extensions of time or fees be necessary in order to maintain this Application in pending condition, appropriate requests are hereby made and authorization is given to debit account # 02-2275.

Respectfully submitted,

LUCAS AND MERCANTI, LLP

By: 
Yaodong Chen L0267
(Attorney for Applicant(s))
475 Park Avenue South
New York, New York 10016
Tel. # (212) 661-8000
Fax # (212) 661-8002

YDC